15 Riprap

Dumped Riprap

Revetment, Class 1, and Class 2 Riprap

Grouted Riprap

Pre-Cast Concrete Riprap

Uniform Riprap

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CHAPTER FIFTEEN: RIPRAP

Riprap is used to protect a slope against erosion or scour and is placed where vegetation or other methods would be ineffective or impracticable. The types of riprap that may be used are:

1) Dumped Riprap

2) Revetment Riprap

3) Class 1 or 2 Riprap

4) Grouted Riprap

5) Precast Concrete Riprap

6) Uniform Riprap

Regardless of the type of riprap used, the foundation grade is required to be stable and true for the riprap to be effective.

DUMPED RIPRAP

Dumped riprap may consist of several different types of material. Often the riprap is waste material that is on the contract. Dumped riprap may consist of any of the following:

1) Broken concrete, masonry, or stone removed from an old structure

2) Broken pieces removed from concrete pavement, base, or monolithic brick pavement

3) Broken rock from Class X or Class Y, unclassified excavation

4) Broken rock from solid rock excavation

5) Material produced from sources outside the right-of-way. These materials are required to be coarse aggregate, class F or higher.

Dumped riprap is placed at locations shown on the plans or as directed by the PE/PS. The placement is required to have the following characteristics:

1) A finished surface of approximate regularity

2) A finish surface varying no more than 9 in. from a true plane

3) A thickness or no more than 2 ft nor less than 1 ft. The thickness is measured perpendicular to the material surface.

REVETMENT, CLASS 1, AND CLASS 2 RIPRAP

Revetment riprap is the most commonly used riprap. Revetment riprap, Class 1 riprap and Class 2 riprap are required to consist of aggregate, Class F or higher. This material is required to be in accordance with Section **904.04** for gradation. The maximum dimension of an individual piece is required to not be greater than three times the minimum dimension and have a gradation as follows:

1) 100% of the materials passes a 18 in. sieve

2) 90 to 100% of the material passes a 12 in. sieve

3) 20 to 40% of the material passes a 6 in. sieve

4) Not more than 10% of the material passes a 3 in sieve

Stone containing shale, unsound sandstone, or any other material which will readily disintegrate may not be used.

Revetment riprap, Class 1 riprap, and Class 2 riprap may be placed by dumping. Revetment riprap is usually placed with a thickness of 18 in. The finished surface may vary no more than 9 in. from a true plane and be free from small clusters of small or large stones. These materials are placed at locations as shown on the plans or as directed by the PE/PS.

GROUTED RIPRAP

Grouted riprap is required to have the same aggregate, preparation of slope, and method of placement as that required for Revetment, Class 1, and Class 2 riprap.

After the aggregate has been placed and accepted, all interspaces are filled with a cement grout. Interspaces are the small spaces between the spalls and the larger aggregate. The grout is composed of 1 part Portland cement to 4 parts of No. 23 fine aggregate. Water is added during mixing until the grout attains a consistency that allows the material to flow into the interspaces.

The finished surface of the grouted riprap is required to be:

1) Smooth

2) Solid

3) True to line

4) True to grade

5) True to section

PRECAST CONCRETE RIPRAP

Precast concrete riprap consists of unreinforced concrete units. The nominal thickness is detailed on the plans or proposal. These units are required to meet minimum concrete compressive strengths and therefore require that samples be taken. The number of samples to be obtained is outlined in the Frequency Manual.

The slope on which riprap is placed is required to be the cross section as shown on the plans. The laying procedure follows the following format:

1) Laying begins in a trench below the toe of the slope and progresses upward

2) Each piece is laid by hand perpendicular to the slope

3) Each piece is firmly embedded against the slope in such manner that the vertical joint space between individual units does not exceed 3/8 in.

4) Half blocks, odd shaped blocks, or class A concrete is used to fill the voids at the ends of sections to be placed or on curved shape sections

5) The top course is required to conform with the prescribed berm or shoulder elevation. Any adjustment necessary to achieve this is obtained by constructing a wedge course near the tip of the slope. This wedge course is Class A concrete or a mixture of one to two mortar. The toe wall, when required, is required to consist of class A concrete.

UNIFORM RIPRAP

Uniform riprap is placed to produce a surface of approximate regularity with the edges having projections no more than 3 in. above the required cross section. This material is hand placed, and the gradation is required to be in accordance with Section **904.04(d)**.

MEASUREMENT

Included below is a table summarizing the different types of riprap and the measuring and payment application of each.

Type and Conditions	Measurement & Payment
Revetment and Dumped from within R/W if shown on the plans	No Payment
Revetment and Dumped from within R/W if placement not shown on the plans	Square Yards
Revetment, Class 1, Class 2, outside of R/W	Tons
Uniform Riprap	Tons
Precast Concrete Riprap	Square Yards
Dumped riprap using blast furnace slag	Order planned tonnage x 2.3 / 2.6; Pay tonnage received x 2.6 / 2.3

ACCEPTANCE

A CAPP “D” number is required for the basis for approval for riprap. Therefore, the technician is required to verify that the riprap is a Certified Material from a CAPP source. Precast concrete riprap requires actual sampling. The Frequency Manual specifies the number of samples required per units used.